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Extended Awareness II Quicklook Report

by

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13. ABSTRACT (Maximum 200 words.)

Extended Awareness II (EA-II) deployed and tested a network-based information system designed to provide enhanced situation awareness (SA) for our military forces engaged in current operations. The network successfully linked a variety of Intelligence, Surveillance, and Reconnaissance (ISR) information providers with a variety of users through reach-back, tactical analysis units, and a convoy operating in the field. Enhanced battlespace awareness at all units was demonstrated. Tactical battlespace information was produced through cross-cueing sensors, information fusion, and real-time tactical analysis, and delivered to operational units within tactically significant time-frames.

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Executive Summary:

"Battlespace Awareness in 2015 provides actionable intelligence to commanders and warfighters. (It) brings to bear a responsive system-of-systems fully integrating personnel, documents, equipment, and technical means in providing persistent, redundant, and tailored coverage."[1]

Extended Awareness II (EA-II) deployed and tested a network-based information system designed to provide enhanced situation awareness (SA) for our military forces engaged in current operations. The network successfully linked a variety of Intelligence, Surveillance, and Reconnaissance (ISR) information providers with a variety of users through reach-back, tactical analysis units, and a convoy operating in the field. Enhanced battlespace awareness at all units was demonstrated. Tactical battlespace information was produced through cross-cueing sensors, information fusion, and real-time tactical analysis, and delivered to operational units within tactically significant time-frames.

Scenario driven operations undertaken by an exercise convoy helped identify requirements for procedures and personnel that will be needed to make full use of these new capabilities. These procedures will be developed into SOPs that will be developed for testing in EA-III.

The technical viability of a new operational, network-based, SA capability has been demonstrated by EA-II. The successes and lessons-learned during EA-II provide the required baseline results for a fuller operational test during EA-III. Successful development and testing of SOP are the next, required steps to deployment of this capability. Current results indicate that progression to operational deployment in the near future is possible.

Extended Awareness II met all JOTBS test objectives. It contributed to the long-range vision of providing actionable intelligence and also demonstrated the possibility for unique and immediate capabilities for use by the edge warfighter.

EA II was a transformational event, improving battlespace awareness and speeding decisions using data from multiple ISR sources transmitted to decision makers for employment of effects. Eight distinct systems (Scan Eagle, Shotspotter, UGS, Joint Mission Support Module (JMSM), Mission Battle Management System (MBMS), Fusion Technology Test Bed (FTTB), Snapshot and Active Data Communications (ADC) were integrated into an IP-based .xml Cursor on Target (CoT) architecture, with a data transmission layer provided via three different communications technologies (HF, 5KHz TACSAT and EPLRS) to the local area tactical network.

[1] Functional Concept for Battlespace Awareness, Joint Staff 2003

Joint Operational Test Bed System (JOTBS)
Extended Awareness II (EA II) Quicklook

Primary EA II Test Objectives and Outcomes:

- Mission Planning: Demonstrate mission planning coordination and interoperability using Cursor on Target (CoT).
    - Finding: CoT provided stability and reliability in the integration of disparate systems and a mechanism for COP dissemination.
    - Impact: There is now a fast, inexpensive approach to achieve interoperability of stovepipe systems, not originally designed to work together. This means information can be efficiently transferred between systems, with resultant improved SA and shortened decision and reaction times.

- Improved Situational Awareness (SA): Demonstrate the capability to provide, via narrowband communications, an ISR-COP to network users, including the tactical commanders. Include: near-real time geo-located display of ISR platforms, sensor points of interest (SPOI), significant target information, and limited Blue force SA data.
    - Finding: All three network systems, TACSAT, EPLRS, and HF, with prioritization management provided by ADC, were able to achieve objectives to varying degrees. All were reliable, but latencies varied widely. HF performance was particularly noteworthy, maintaining virtually the same bandwidth (5 kHz) as the TACSAT. Products successfully delivered included, in addition to the COP, imagery, reduced frame video, and chat data.
    - Impact: This brings new SA to tactical commanders on the move who now have limited visibility into ISR products. So much data was delivered that the CC-M was challenged to ingest it; identifying the need for improved human systems integration engineering.

- Cueing coordination: Achieve cueing coordination for mobile target acquisition and engagement using dissimilar sensors to cue EO/IR sensors.
    - Finding: Shotspotter successfully provided high resolution acoustically-derived data from ground sensors on suspected small arms firing events which were machine-to-machine transmitted to the UAS for auto-slewing of the EO sensor, while simultaneously being ingested into the ISR-COP. Likewise, UGS simulation provided acoustic data on enemy vehicle activity to LYNX/SAR GMTI, which in turn stimulated Scan Eagle imagery of the target vehicle.
    - Impact: Machine-to-machine cueing provided significant reductions in reaction times to tip complimentary sensors and improved ingest to the ISR-COP for improved tracking, localization, and targeting.

- Reachback support: Demonstrate effective two-way communications between JMSM and reachback centers (RBCs).
    - Finding: Collabcast provided reliable two-way SATCOM connectivity between the JMSM network and JFL, Suffolk, VA. This effectively linked the RBC directly to all network participants, including sensors (e.g. UAS) and the

tactical commander and allowed JFL to task Scan Eagle for specific imagery. HF was used to connect JMSM to TAAC, NMSU, which tasked Scan Eagle via JMSM's TACSAT link.
    - Impact: RBCs are able to function as integral players in the tactical scenario, providing in-depth expertise to increase combat effectiveness and resolve difficult problems. For context, they can receive ISR-COP and have full BA.

- JMSM-FTTB integration: Demonstrate effective two-way communications between the JMSM and FTTB for archiving, reachback, and fusion of sensor/target data.
    - Finding: JMSM and FTTB integrated impressively. Information was shared seamlessly between them and FTTB supported JMSM in the comparison of images, sensor fusion, auto-tasking of sensors, and virtually seamless simulation.
    - Impact: The effectiveness of interoperability between these key players will speed overall SA, mission planning, and targeting decisions and improve economies in operations of assets.

EA II Overview and Major Accomplishments:

System elements combined an Unmanned Air System (UAS), data fusion (DCGS-A surrogate), and information dissemination capabilities in multiple live-fly events at Ft. Huachuca, AZ from 11-20 July 2005. JFCOM Joint Operational Test Bed System (JOTBS) technical and operational objectives were developed for this event, a spiral towards full IOC of capabilities described in the FCBA.[2] A convoy scenario tested a range of technical capabilities and provided an opportunity to develop next steps in improved TTP that are of immediate warfighting use, especially in support of commander on the move in convoy operations. EA II demonstrated the potential to improve battlespace awareness by providing multiple-source sensor data to a Convoy Commander on the Move (CC-M). Data provided to the commander on the move should improve situational awareness, although in EA II, the ability for the commander on the move to use all of the information provided was not determined. In some cases, the commander on the move found the additional data provided forward needed further refinement in order to be used at the "edge," and within the tactical time frame they are engaged in. In short, EA II demonstrated for comparison, technical means to move the right information to the warfighter in a timely manner, and in a seamless format (Cursor on Target, CoT) connecting everyone from the Mission Coordinator to the Commander on the Move in a data-centric environment. Through this approach, a greater range of information, knowledge and action is made available to the warfighter, in a much shorter timeline. Integration of this information by the edge user requires additional human-systems integration, and development of TTP. Appendices A and B summarize the system elements, architecture, and participants in EA II.

EA II Specific Accomplishments and Potential Warfighting Impacts

- Mission planning coordination and interoperability between mission controllers (JMSM), fusion centers (FTTB and JFL), and the commander on the move was achieved via Cursor on Target (CoT) .xml schema.

G

Discussion of findings: CoT provided the means to integrate systems and intelligence information, viewable on Falcon View via a common .xml schema. Icons need improvement, as seen in Appendix C, but this is easily remedied with lessons learned from EA II. This improved SA throughout the battlespace.

Impact: Use of CoT is a known capability. EA II extended its use to real-time integration of multiple sensor data that could be fused with additional intelligence and provided to a commander on the move via chat, and a common operational picture. This capability was tested in three communications architectures, TACSAT, EPLRS, and HF. Where it is possible to provide an EPLRS network, this was demonstrated to have the greatest capability to support the range of intelligence information (reduced frame video, chat,

[2] Ibid.

Falcon View) to the edge warfighter. EA II was the first demonstration of EPLRS used to send information via an IP network.

- Scan Eagle was employed as a surrogate for a small UAS capability, but demonstrated the utility of a UAS combined with time critical requirements. G

Discussion of findings: Scan Eagle is a very light (40 lb with payload and fuel) unmanned air vehicle with EO and IR sensor packages (only one at a time). It demonstrated the capability to provide video (via its own network, to a ground control station) and to image specific targets via a machine-to-machine interface. This "auto-slew" capability was demonstrated in a M2M mode with Shotspotter, as shots were fired, the position information was passed through the network configuration directly to Scan Eagle, which then positioned its sensors on that position. In addition, with limited payload standard IFF integration is impractical. Cursor on Target and Falcon View were provided the range air traffic control, providing real time Scan Eagle position, and safety of flight information. In future, this approach may provide an alternative to standard expensive and weighty IFF standard systems not appropriate to small UASs.

Impact: The concept of small, organic UASs combined with CoT information dissemination and machine to machine cueing provides the warfighter with almost immediate SA of the immediate battlespace. These systems are available now, and data architectures to support the CC-M can be constructed with available technologies. CoT provides an immediate potential path.

- The Mission Battle Management System (MBMS) was able to successfully plan, monitor and re-task Scan Eagle missions in real time. G

Discussion of findings: MBMS was used successfully to re-task the Scan Eagle in a time critical event.

Impacts: MBMS will be essential in future complex UAV operations. In a sensor-rich environment, the MBMS will be needed to optimize use of the assets, provide separation planning, and re-task assets as the battlespace requirements shift.

- Narrowband communications (EPLRS [line of sight (LOS)], PRC-117 [TACSAT], and HF), provided an ISR-Common Operating Picture (ISR-COP) via Falcon View simultaneously to the commander on the move and all others on the network. Data converted to information provided near-real-time geographic display of the geo-location of platforms, sensor point of interest (SPOI), significant target information, and limited Blue force position data. G

Discussion of findings: TACSAT was reliable but 35 to 40 second information latency was noted, especially for chat. This presented the CC-M problems in short decision-cycle events. Reduced frame video (RFV) to the CC-M could not be transmitted via TACSAT. Enhanced Position Location Reporting System (EPLRS) was demonstrated in

a data/internet protocol (IP) configuration, after some initial configuration problems. Changes to equipment configurations provided reliability, and information latency in chat was minimal. Reduced frame video (RFV) of about two frames per second was successful via EPLRS and can thus provide the CC-M with much enhanced SA. HF provided very reliable communications for the short test period in which it was employed. The CC-M was also supported by chat via HF, which was in an escort vehicle (CU-E).

Impact: Both EPLRS and HF support SA to the CC-M. Further improvements to the reduced frame video are expected with additional work. The IP via EPLRS is an advance not possible without EA II, and should be further defined in TTP.

- Employment of narrowband communications to transmit/distribute electro optic/infrared (EO/IR) video and/or images to users of the ISR [Command and Control] C2 network, including the command vehicle on the move.

G

Discussion of findings: Quality of service and bandwidth management provided by Active Data Communications (ADC) made it possible for low bandwidth systems to pass EO video and chat data. CoT tools greatly enhanced CC-M SA. Human systems integration of technical means and employment in vehicles on the move will need to be refined to reach full capability. Tailoring of information to prevent information overload needs to be improved.

Impact: Even with limited provisions made for use of laptops in vehicles, Snapshot imagery passed to the CC-M was extremely useful to the CC-M, and is a prime example of the principal of Battlespace Awareness.

- Coordinated cues for mobile target acquisition engagement using dissimilar sensors, i.e. non-EO/IR sensor (SAR/GMTI) to cue EO/IR sensors.

G

Discussion: Scan Eagle, the surrogate for notional UAS sensor capabilities provided a stable platform with high optical resolution. Shotspotter provided high resolution location position from acoustic derived data of firing information that was then transmitted to the UAS via a machine- to-machine CoT messages. UGS detection simulations cued a simulated LYNX/SAR GMTI track which in turn was the stimulus for Scan Eagle imagery of the target vehicle.

Impact: Battlespace awareness will be achieved with a spectrum of sensor capabilities. EA II demonstrated means to bring these capabilities together for increased SA and decision making. CoT, as the information dissemination means is necessary to integrating these dissimilar capabilities.

- Established an information bridge and functional capability between the Joint Mission Support Module (JMSM) and the Fusion Technology Test Bed (FTTB) for archiving, reachback, and fusion of sensor/target data.

G

Discussion: The JMSM and FTTB sharing information together, and working the fusion of multiple sources is a significant breakthrough. In future, it is possible that the capabilities of the JMSM and FTTB could be combined virtually or through reach-back. FTTB, on request from the JMSM, compared archived images from the area of interest (AOI) with near-real-time (NRT) images and communicated as assessment of the comparison to the JMSM.

Impact: Improved sensor fusion by intelligence experts, and presenting this knowledge to the operational network that includes the warfighter.

- Employ Collabcast two-way broadband connectivity with Joint Futures Lab (as a reach back surrogate).

G

Discussion of findings: Collabcast, a commercial broadband provider maintained end-to-end network connectivity between the JFL in Norfolk VA to the JMSM and units on the move in Ft Huachuca. This connectivity combined with SA provided by CoT significantly reduced time between HUMINT tipper to Scan Eagle being able to put a sensor on target.

Impacts: Employment of broadband capabilities at reachback positions will be necessary in future sensor-rich environments and where additional intelligence resources can contribute to battlespace awareness.

Appendix A
System Elements and Architecture

Situation Awareness (SA) Systems and Capabilities:

- The Joint Mission Support Module (JMSM) II is a trailer housing work stations, communications and computer racks and equipment that enabled the Mission Coordinator (MC) to manage sensor tasking and data/information dissemination.
- Cursor on Target (CoT) provided position data via .xml format of all platforms/sensors/targets and sensor points of interest for display on Falcon View on standard military workstations, including still imagery & video.
- FTTB/DCGS-Army (A) is a DCGS-A portal that was the primary fusion center between JOTBS systems and other ISR systems within the Global Information Grid (GIG). The FTTB also provided simulated SAR/GMTI sensor inputs to the data stream into the JMSM.
- Mission Battle Management System (MBMS) provided dynamic UAS prioritization, coordination & mission planning, important in a sensor rich environment.
- Mobile Units – convoy commander on the move (CC-M) and escorting combat unit on the move (CU-E) were housed in vehicles with equipment that allowed CoT display, interaction and communication with all other units.
- Reachback Centers were established at the Joint Futures Laboratory (JFL), Suffolk, VA, and the Technical Analysis and Applications Center (TAAC), New Mexico State University (NMSU).

Sensor Systems:

- Scan Eagle UAS with electro-optical (EO) sensor.
- Shotspotter, a ground gunshot acoustic locating system with an inherent capability to track Blue forces.
- Simulated Unattended Ground Sensors (UGS) provided an additional sensor for cueing data on Red vehicles into the COP.

Communications Systems: Three IP-based network communication paths were used for simultaneous chat, imagery and data transmission to all network participants and a fourth linked to an RBC.

- PRC-117 SATCOM radio network
- Enhanced Position Location Reporting System (EPLRS) LOS-based network
- HF radio
- Collabcast, a two-way IP-based Global Broadcast System (GBS) linked the JMSM to the JFL RBC in Suffolk, VA.

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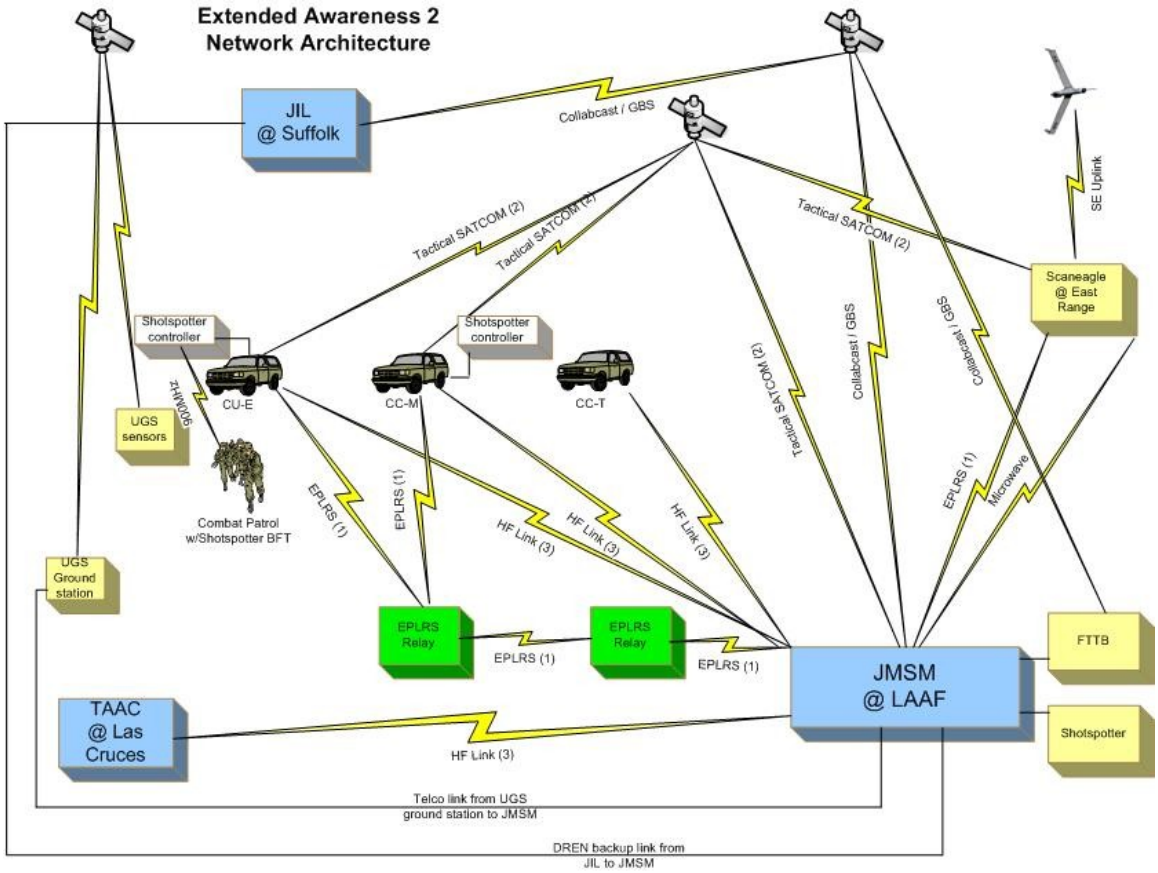


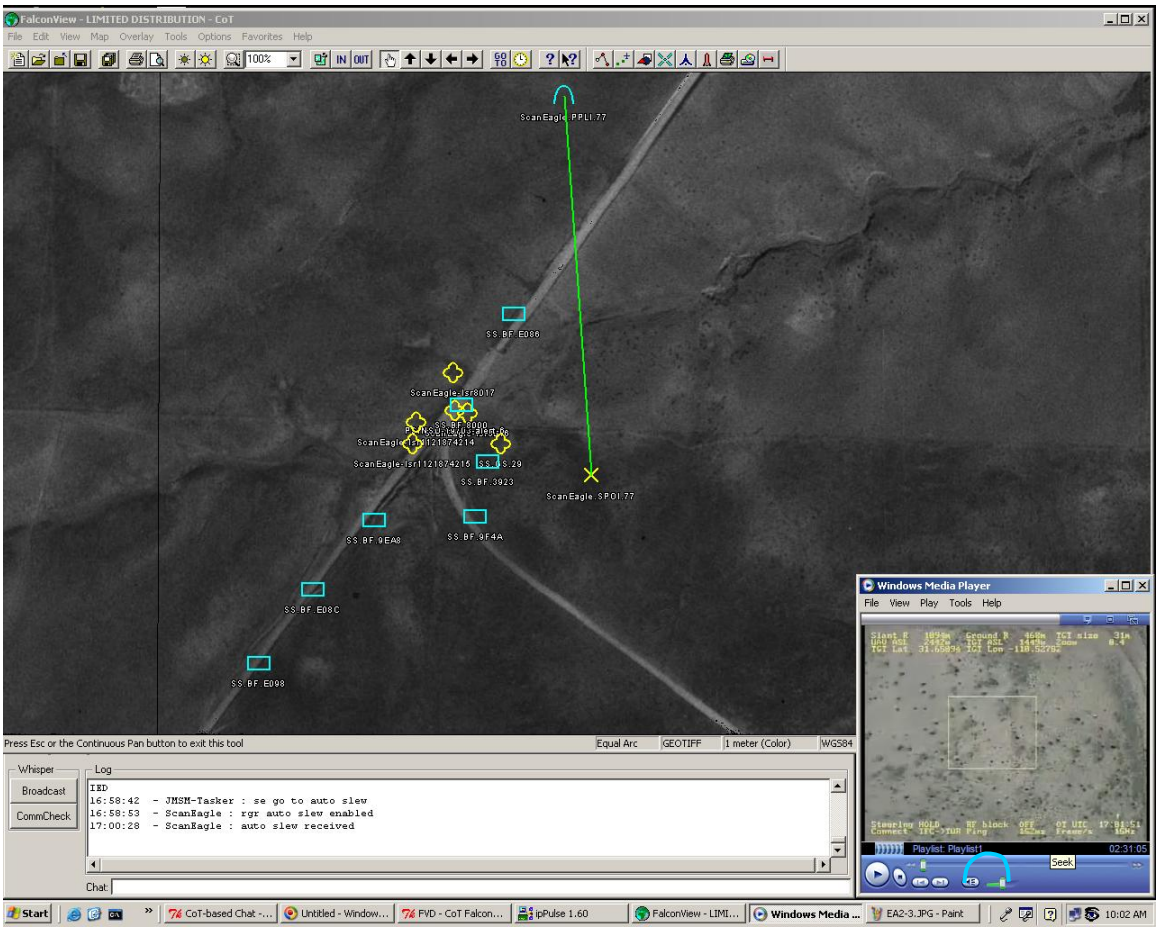
<u>Notes</u>:
(1) During MF-1 CC-M and CU-E connectivity will be EPLRS only
(2) During MF-2 CC-M and CU-E connectivity will be Tactical SATCOM only.
(3) During MF-3 CC-M and CU-E connectivity will be HF only.
(4) CC-T connectivity will be HF on all events.
(5) All vehicles and dismounts will be equipped with Shotspotter sensors for BFSA.

Appendix B
Participants

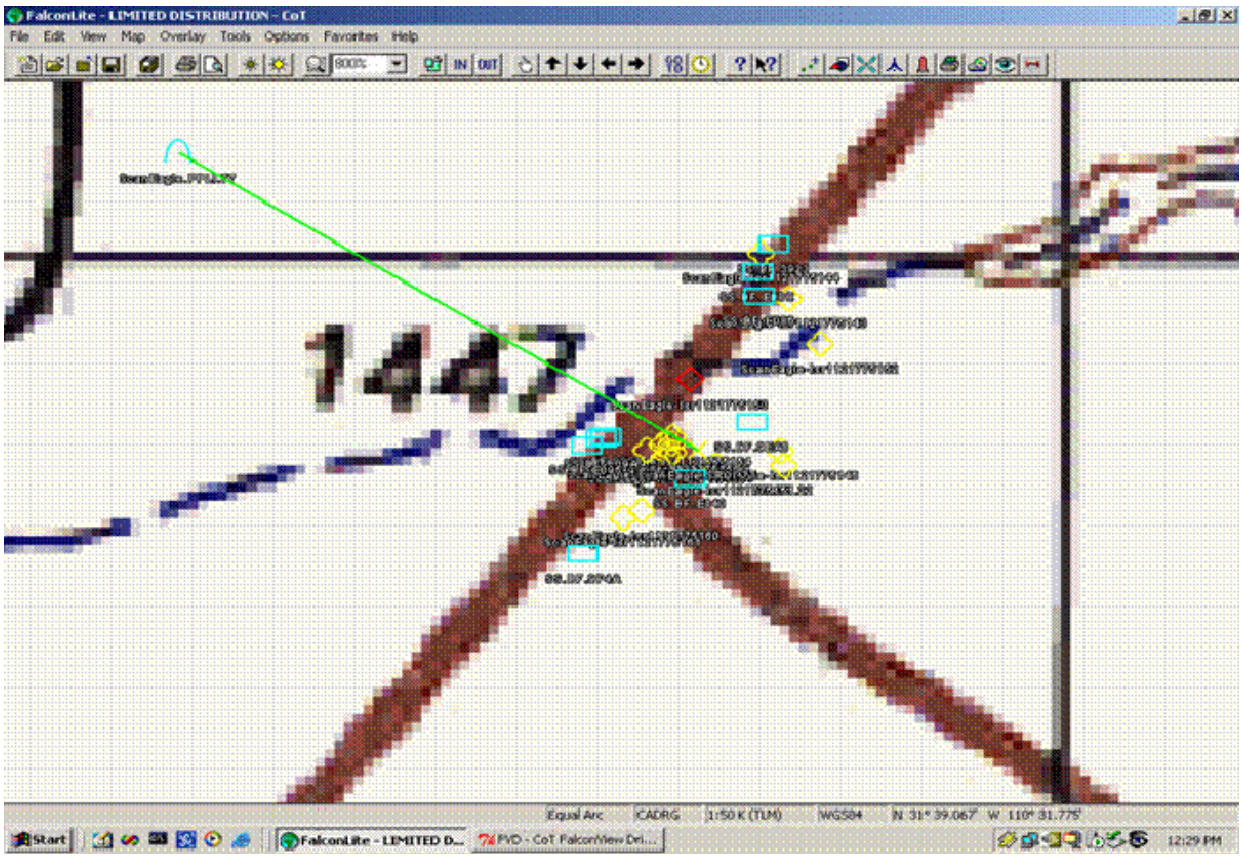
EA II was a partnership between JOTBS and a number of government and commercial organizations.

1. USAF Electronic Systems Center (ESC) & MITRE - Cursor-on-Target (CoT) capability integration
2. Army CECOM/I2WD Fusion Technology Test Bed (FTTB) for integration of the DCGS-A with the CoT network & LYNX SAR/GMT integration (risk rediction for live SAR/GMT in EAIII)
3. Army CECOM/I2WD LYNX SAR/GMT integration
4. Shotspotter Inc. – Shotspotter gunshot acoustic locating and Blue force tracking system (part of ongoing company research and development)
5. Boeing/Insitu Group – Scan Eagle UAS
6. SPAWAR (Neptune Sciences, Inc.) – Unattended Ground Sensors (UGS) for vehicle detection systems and METOC (Klett Consulting Group) for ground-level meteorological conditions provided additional sensor types for integration into the netted sensor architecture.
7. Harris Corp – Active Data Communications (ADC) for prioritization of data across the network; highest priority data to the user first in a constrained bandwidth environment
8. DISA – Collabcast. Two day collaboration between JFCOM and Joint Futures Lab (JFL)
9. Lockheed Martin Corporation – Mission Battle Management System (MBMS) for automated dynamic management of ISR assets, risk reduction for more robust EAIII environment
10. Battlespace Inc – support contractor for JFCOM/JOTBS.
11. Joint Futures Laboratory (JFL), Suffolk VA – reachback center for imagery
12. Technical Analysis and Applications Center (TAAC), New Mexico State University (NMSU) – reachback center for UAV technical support
13. The Naval Postgraduate School, assisted by Naval Reserve Officers from the Office of Naval Research Science and Technology Units 102, 111, 112, 113 provided the assessment of EA II.

Appendix C
Representative Screen Captures



19 July Falcon View image. (1 meter).
Visible icons: inverted blue "u" (Scan Eagle w/ Sensor Point of Interest); Blue rectangles (3 vehicle convoy); and yellow cloverleaves (unknown targets). Note the concentration of icons and the difficulty in interpreting them.
Inset photo is Scan Eagle live video feed.



19 July Falcon View image. 1:50,000 scale, zoomed-in completely. Visible icons: red diamond ◇ (hostile ground target); inverted blue u ∩ (Scan Eagle w/ Sensor Point of Interest); Blue rectangles ▭ (3 vehicle convoy); and yellow cloverleaves ✿ (unknown targets). Note the concentration of icons, the difficulty in interpreting them, and the high degree of pixelization.

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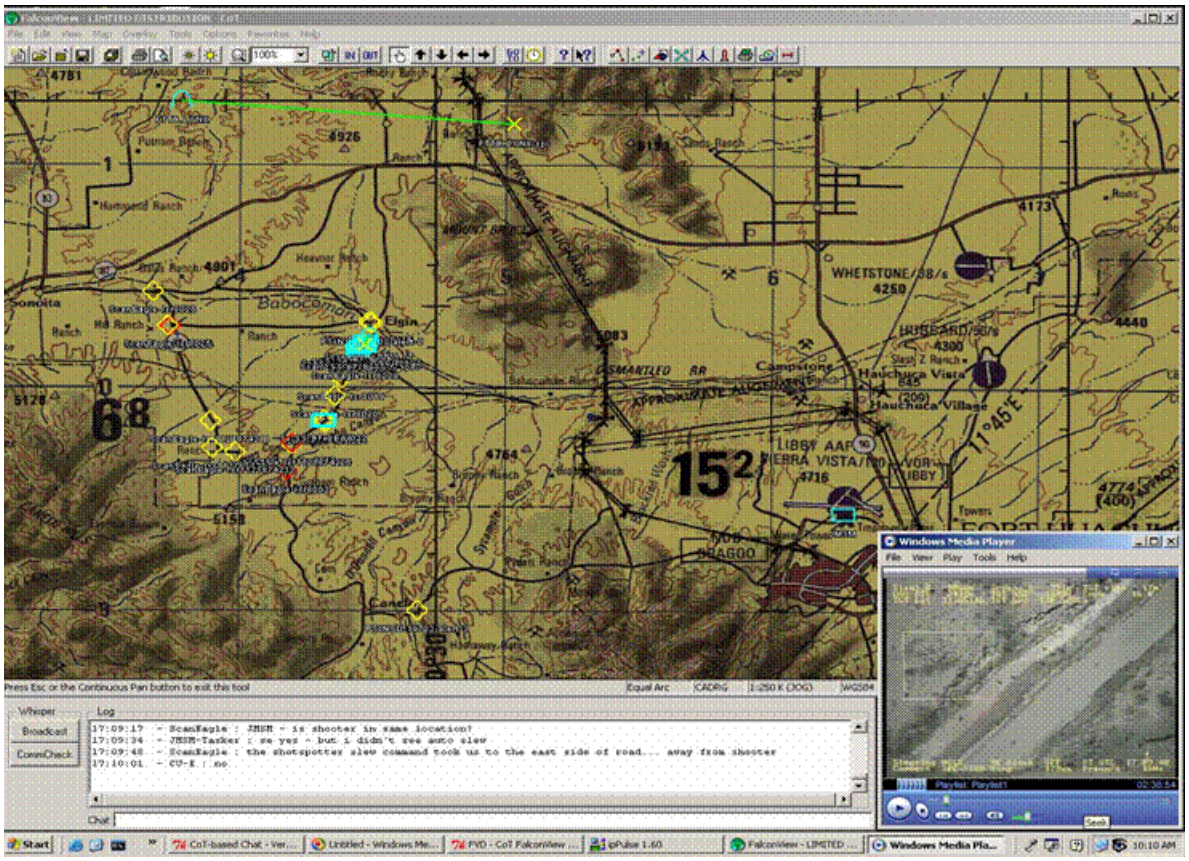
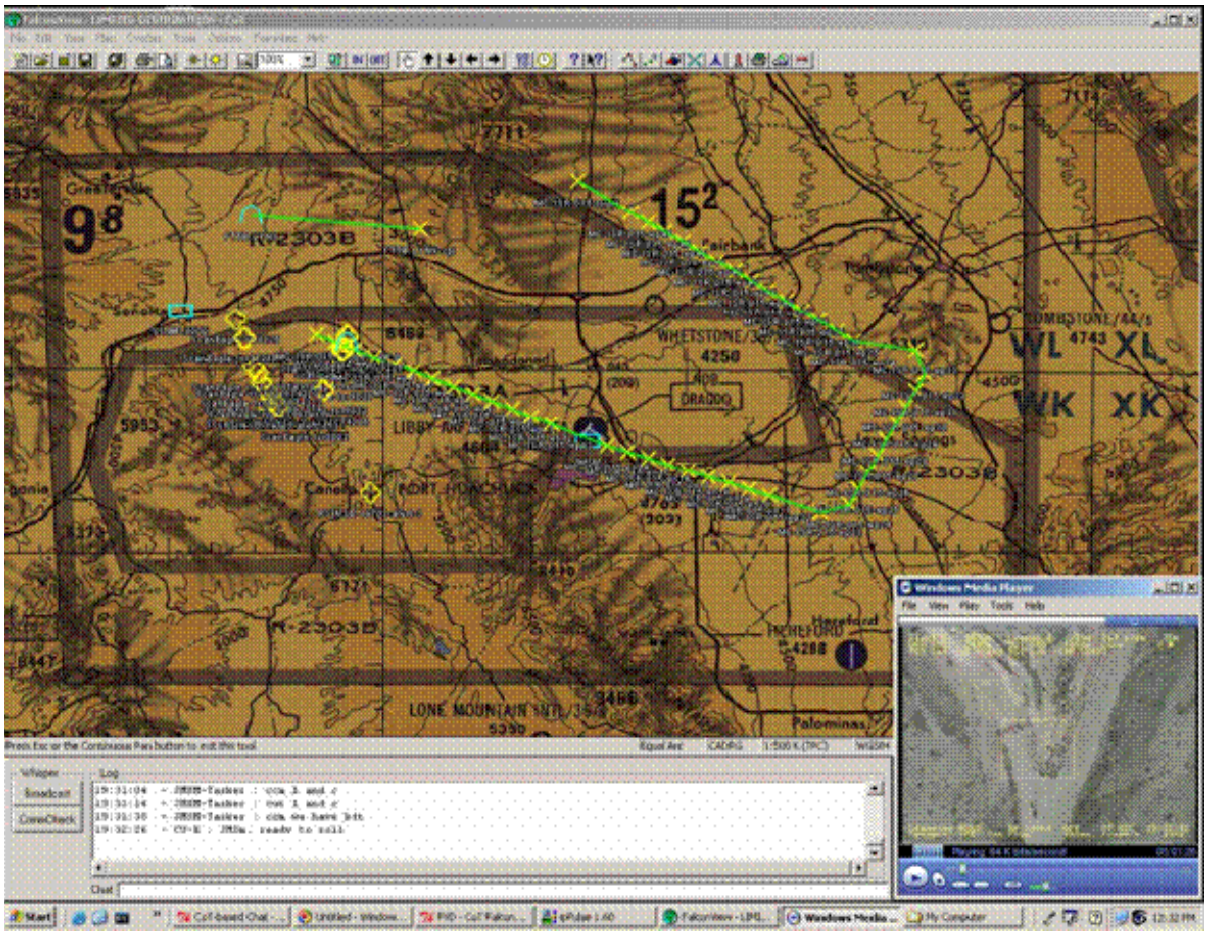


20 July Falcon View image. 1:250,000 scale, zoomed out.
Visible icons are: inverted blue "u" (Scan Eagle w/ Sensor Point of Interest); blue rectangles (Blue force convoy of 3 vehicles); and yellow cloverleaves (unknown targets). Note the concentration of icons and the difficulty in interpreting them. Inset photo is Scan Eagle live video feed.



20 July Falcon View image. 1:500,000 scale, zoomed out.
Green line with yellow 'X's is MBMS generated flight plan. Visible icons are: inverted blue "u" ∩ (Scan Eagle w/ Sensor Point of Interest); blue rectangles ▭ (Blue force convoy of 3 vehicles); and yellow cloverleaves (unknown targets). Note the excess waypoints generated by MBMS. Inset photo is Scan Eagle live video feed.

Appendix D
Acronyms

ADC	Active Data Communications (a bandwidth management system)
AJCN	Adaptive Joint C4ISR Node
AOI	Area of Interest
ASL	Above Sea Level
ATC	Air Traffic Control
BA	Battlespace Awareness
BAFC	Battlespace Awareness Functional Concept
BFT	Blue Force Tracking
C2	Command and Control
C4ISR	Command, Control, Communications, and Computer ISR
CC-M	Convoy Commander on the Move
CC-T	Convoy Commander Trail Vehicle on the Move
Collabcast	Two-way IP-Band Global Broadcast System
COP	Common Operating Picture
CoT	Cursor on Target
CU-E	Convoy Unit Escort Commander on the Move
DCGS-A	Distributed Common Ground Station-Army
EA	Extended Awareness
EO	Electro-Optical
EPLRS	Enhanced Position Location Reporting System
Falcon View	A map orientation software
FTTB	Fusion Technology Test Bed
GBS	Global Broadcast System
GCS	Ground Control Station
GDT	Ground Datalink Terminal
GIG	Global Information Grid
GMTI	Ground Moving Target Indicator
HF	High Frequency
HUMINT	Intelligence data derived from human sources.
IFF	Identification Friend or Foe
IP	Internet Protocol
IR	Infra-red
ISR	Intelligence, Surveillance, and Reconnaissance
JFL	Joint Futures Laboratory
JIL	Joint Intelligence Laboratory
JMSM	Joint Mission Support Module
JOTBS	Joint Operational Test Bed System
LAAF	Libby Army Air Field (Ft. Huachuca, AZ)
LAN	Local Area Network
LOS	Line of Sight (communications links)
LSA	Logistics Staging Area
M2M	Machine-to-Machine (automatic)

MAJIIC	Multi-sensor Aerospace-Ground Joint ISR Interoperability Coalition
MBMS	Mission Battle Management System
MC	Mission Coordinator
METOC	Meteorology and Oceanography
MF	Mission Flight
MHz	Megahertz
MITRE	A Federally Funded Research and Development Center (FFRDC)
NIIRS	National Imagery Interpretability Rating Scale (A subjective rating of the quality of imagery by an SME)
NMSU	New Mexico State University
NRT	Near Real-Time
PRC-117F	A man portable SATCOM or Line of Sight UHF/VHF radio
QoS	Quality of Service
RBC	Reach Back Center
RCS	Return Channel Satellite
RF	Radio Frequency
RFV	Reduced Frame Video
RFVD	Reduced Frame Video Distribution
SA	Situational Awareness
Scan Eagle	Small UAS
SAR	Synthetic Aperture Radar
SATCOM	Satellite Communications
Shotspotter	Ground Acoustic Sensor Network
SIGINT	Signals Intelligence
SME	Subject Matter Expert
SPOI	Sensor Point of Interest
TAAC	Technical Analysis and Applications Center
TTP	Tactics, Techniques & Procedures
UAS	Unmanned Air System
UAV	Unmanned Aerial Vehicle
UGS	Unattended Ground Sensor
USJFCOM	United States Joint Forces Command
XML	Extensible Markup Language

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